

WHAT IS CLAIMED IS:

1. A lithographic method for forming a pattern in a film carried on a substrate, comprising the steps of:

5 depositing a film on a substrate to provide a mold having a protruding feature and a recess formed thereby, the feature and the recess having a shape forming a mold pattern;

10 urging the mold into the film whereby the thickness of the film under the protruding feature is reduced and a thin region is formed in the film;

15 removing the mold from the film;

processing the relief whereby the thin region is removed exposing a portion of the surface of the substrate which underlies the thin region; and

20 whereby the exposed portion of the surface of the substrate substantially replicates the mold pattern,

the improvement comprising at least a portion of said protruding feature and a portion of said release have bonded thereto a release material comprising an inorganic linking group bonded to a molecular chain having release properties.

25 2. The method of claim 1 wherein said release material comprises a material having the formula:

RELEASE-M(X)<sub>n-1</sub>-

or

25 RELEASE-M(OR)<sub>n-1</sub>-, wherein

RELEASE is a molecular chain of from 4 to 20 atoms in length, preferably from 6 to 16 atoms in length, which molecule has either polar or non-polar properties;

30 M is a metal or semimetal atom;

X is halogen or cyano, especially Cl, F, or Br;

R is hydrogen, alkyl or phenyl, preferably hydrogen or alkyl of 1 to 4 carbon atoms; and;

(n) is the valence -1 of M.

3. The process of claim 2 wherein RELEASE comprises a highly fluorinated organic group.

5 4. The process of claim 3 wherein said highly fluorinated group comprises a perfluorinated alkyl group.

5. The process of claim 2 wherein M is Si.

10 6. The process of claim 2 wherein X is halogen.

7. The process of claim 2 wherein X is chloro or bromo.

8. The process of claim 6 wherein M is Si.

15 9. The process of claim 7 wherein M is Si.

10. A process for improving the release properties of a surface comprising:

20 a) providing a surface;

b) contacting that surface with a release forming material wherein said release forming material comprises a material having the formula:

RELEASE-M(X)<sub>n-1</sub>-

25 or

RELEASE-M(OR)<sub>n-1</sub>-, wherein

RELEASE is a molecular chain of from 4 to 20 atoms in length, preferably from 6 to 16 atoms in length, which molecule has either polar or non-polar properties;

30 M is a metal or semimetal atom;

X is halogen or cyano, especially Cl, F, or Br;

R is hydrogen, alkyl or phenyl, preferably hydrogen or alkyl of 1 to 4 carbon atoms; and;

35 (n) is the valence -1 of M.



RELEASE is a molecular chain of from 4 to 20 atoms in length, preferably from 6 to 16 atoms in length, which molecule has either polar or non-polar properties;

5                   M is a metal or semimetal atom;

5                   X is halogen or cyano, especially Cl, F, or Br;

10                  R is hydrogen, alkyl or phenyl, preferably hydrogen or alkyl of 1 to 4 carbon atoms; and;

10                  (n) is the valence -1 of M,  
said material being bonded to said surface only through a bond directly to M  
10                  where a group X or OR has been removed to enable bonding to said surface,  
with the group RELEASE still attached to M.

20. The surface of claim 19 wherein said material comprises a material of the formula:

15                  RELEASE-M(X)<sub>n-1</sub>-  
                        wherein

20                  RELEASE is a molecular chain of from 4 to 20 atoms in length, preferably from 6 to 16 atoms in length, which molecule has either polar or non-polar properties;

20                  M is a metal or semimetal atom;

20                  X is halogen or cyano, especially Cl, F, or Br; and

20                  (n) is the valence -1 of M.

25                  21. The surface of claim 20 wherein RELEASE comprises a highly fluorinated group.

25                  22. The surface of claim 21 wherein said highly fluorinated group comprises a perfluorinated group.

30                  23. The surface of claim 22 wherein said highly fluorinated group comprises a perfluorinated group of from 4 to 16 carbon atoms.

35                  24. The surface of claim 20 wherein M is Si.

25. The surface of claim 21 wherein M is Si.

26. The surface of claim 22 wherein M is Si.

5 27. The surface of claim 23 wherein M is Si.

28. A surface having good antiadherent properties comprising a surface having bonded thereto the material of the formula:

RELEASE-M(X)<sub>p-2</sub>

10 or

RELEASE-M(OR)<sub>p-2</sub>, wherein

RELEASE is a molecular chain of from 4 to 20 atoms in length, preferably from 6 to 16 atoms in length, which molecule has either polar or non-polar properties;

15 M is a metal or semimetal atom;

X is halogen or cyano, especially Cl, F, or Br;

R is hydrogen, alkyl or phenyl, preferably hydrogen or alkyl of 1 to 4 carbon atoms; and;

20 p is the valence of M,

said material being bonded to said surface only through a bond directly to M.

29 The surface of claim 19 wherein the surface comprises a

25 patterned mold surface.

30. The method of claim 1 including heating the thin film to a temperature to allow sufficient softening of the film relative to the mold prior to the step of urging.

30 31. The method of claim 1 wherein the feature on the mold is formed from material selected from the group consisting of: semiconductors, dielectrics, metals, ceramics, polymers and their combination.

32. The surface of claim 19 wherein said surface comprises a material selected from the group consisting of: semiconductors, dielectrics, metals, ceramics, polymers and their combination.

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33. The method of claim 1 wherein the step of processing comprises reactive ion etching.

34. The method of claim 1 including repeating the steps of obtaining  
10 a mold, urging, removing, and processing to form a multilayered device.

35. The method of claim 9 wherein the material is selected from the group consisting of semiconductors, dielectrics, metals, ceramics, polymers, and their combination.

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36. A lithographic method for forming a pattern in a film carried on a substrate, comprising the steps of:

obtaining a substrate having a release coating thereon formed by  
20 the reaction of a compound of the formula

RELEASE-M(X)<sub>n-1</sub>-

or

RELEASE-M(OR)<sub>n-1</sub>-, wherein

25 RELEASE is a molecular chain of from 4 to 20 atoms in length, preferably from 6 to 16 atoms in length, which molecule has either polar or non-polar properties;

M is a metal or semimetal atom;

X is halogen or cyano, especially Cl, F, or Br;

30 R is hydrogen, alkyl or phenyl, preferably hydrogen or alkyl of 1 to 4 carbon atoms; and;

(n) is the valence -1 of M,

depositing a film on the substrate;

obtaining a mold having a protruding feature and a recess formed thereby, the feature and the recess having a shape forming a mold pattern;  
5 urging the mold into the film creating a thickness contrast pattern in the film;  
removing the mold from the film; and  
transferring the thickness contrast pattern in the film onto the substrate.

37. A process for improving the release properties of a surface comprising:

10       a) providing a surface;  
b) contacting that surface with a release forming material wherein said release forming material comprises a material having the formula:  
RELEASE- $M(X)_{n-m-1}Q_m$ ,

15       RELEASE is a molecular chain of from 4 to 20 atoms in length, preferably from 6 to 16 atoms in length, which molecule has either polar or non-polar properties;  
M is a metal or semimetal atom;  
X is halogen or cyano, especially Cl, F, or Br;  
Q is a hydrogen or alkyl group,  
20       m is the number of Q groups,  
n-m-1 is at least 1, and  
n is the valence -1 of M.

38. The process of claim 2 wherein said release material comprises a material  
25       having the formula:

RELEASE- $M(X)_{n-1-}$ .

39. The surface of claim 28 wherein said release material comprises a material  
having the formula:  
30       RELEASE- $M(X)_{n-1-}$ .

40. The process of claim 38 wherein M is Si;  
X is halogen Cl or Br;  
RELEASE is perfluoroalkyl of 6 to 20 carbon atoms;  
35       and

n is 3.

41. The surface of claim 39 wherein M is Si;

X is halogen Cl or Br;

5 RELEASE is perfluoroalkyl of 6 to 20 carbon atoms

and

n is 3.

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